

Claims

1. Device and process for generation of a partly synthesized high-quality signal for acceleration of an armature of an electric drive, characterized in that the rotary acceleration α of the rotated armature or, in the case of a travelling wave drive with armature set in linear movement, the linear acceleration α of the armature set in linear movement, is registered metrologically by an accelerometer mechanically connected to this armature and preferably operating on the Ferraris principle, or, in the case of a travelling wave drive with armature set in linear movement by an accelerometer preferably operating on the Ferraris principle transposed to linear movement and is consequently available as measured acceleration signal $b_m = \alpha \cdot F_g(p)$, with $F_g(0) = 1$, here representing the so-called measurement transfer function, and in that the torque m , or in the case of a travelling wave drive with armature set in linear movement, the linear force f of the drive hereinafter designated as substitute acceleration signal $b_E = m$, or in the case of a traveling wave drive with an armature set in linear movement, designated as substitute acceleration signal $b_E = f$, is also registered metrologically and accordingly is available as measured substitute acceleration signal b_{Em} , it being assumed thereafter, as is customary in automatic control engineering, that on the one hand the measured acceleration signal b_m and on the other the measured substitute acceleration signal b_{Em} , all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque to the position of the rotated part of the rotary acceleration meter at which the effect used for registration of acceleration is

generated being taken as a basis, or, in the case of a travelling wave drive with armature set in linear movement, a mechanically absolutely rigid connection from the surface of the armature set in linear movement which is engaged by the linear thrust of the drive to the position of the part of the linear accelerometer at which the effect used for registration of acceleration is registered, is each scaled so that the relation $b_m = \alpha \quad F_g(p) = b_{Em} \quad F_g(p)$ is satisfied, and characterized in that the measured acceleration signal b_m is delivered to the input of a low-pass filter with the low-pass transfer function $FT(p)$, $FT(0)$ preferably equalling 1, so that the signal $x = b_m \quad FT(p)$ can be received at the output of the low-pass filter, and in that the measured substitute acceleration signal b_{Em} is delivered to the input of a high-pass filter with high-pass transfer function $FH(p) = FT(0) - FT(p) \quad F_g(p)$, and so the signal $y = b_{Em} [FT(0) - FT(p) \quad F_g(p)]$ may be received at this high-pass filter, and in that a signal $z = b_m \quad FT(p) + b_{Em} [FT(0) - FT(p) \quad F_g(p)]$ is now formed in accordance with the relation $z = x + y$ and this synthesized signal z is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question or, in the case of a travelling wave drive with armature set in linear movement, as a very high-quality dynamic substitute as the undelayed instantaneous value of the linear acceleration α of the armature set in linear movement in automatic control of the drive in question.

2. A device and a process as described in Claim 1, wherein the rotary acceleration α of the rotated armature of a rotary current drive is registered metrologically by an accelerometer mechanically connected to this armature and preferably operating

on the Ferraris principle, and is consequently available as measured acceleration signal $b_m = \alpha \quad F_g(p)$. $F_g(p)$, with $F_g(0) = 1$, here representing the so-called measurement transfer function, and wherein the torque m , hereinafter designated as substitute acceleration signal $b_E = m$, is registered metrologically and accordingly is available as measured substitute acceleration signal b_{Em} , it being assumed thereafter, as is customary in automatic control engineering, that on the one hand the measured acceleration signal b_m and on the other the measured substitute acceleration signal b_{Em} , all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque to the position of the rotated part of the rotary acceleration meter at which the effect used for registration of acceleration is generated being taken as a basis, is each scaled so that the relation $b_m = \alpha \quad F_g(p) = b_{Em} \quad F_g(p)$ is satisfied, and wherein the measured acceleration signal b_m is delivered to the input of a low-pass filter with the low-pass transfer function $F_T(p)$, $F_T(0)$ preferably equalling 1, so that the signal $x = b_m \quad F_T(p)$ can be received at the output of the low-pass filter, and wherein the measured substitute acceleration signal b_{Em} is delivered to the input of a high-pass filter with high-pass transfer function $F_H(p) = F_T(0) - F_T(p) \quad F_g(p)$, and so the signal $y = b_{Em} \quad [F_T(0) - F_T(p) \quad F_g(p)]$ may be received at this high-pass filter, and wherein a signal $z = b_m \quad F_T(p) + b_{Em} \quad [F_T(0) - F_T(p) \quad F_g(p)]$ is now formed in accordance with the relation $z = x + y$ and this synthesized signal is subsequently used as a very high-quality dynamic substitute for the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question.

3. A device and a process as described in Claim 2, wherein, rather than the torque m of the drive, use is made of the directly torque forming transverse-current component i_q of the current volume indicator of the winding fed by transverse current of the drive substitute acceleration signal $bE = i_q$.

4. A device and a process as described in Claim 1, wherein the linear acceleration α of an armature set in linear movement of a travelling wave drive is registered metrologically by an accelerometer preferably operating on the Ferraris principle transposed to linear movement and is consequently available as measured acceleration signal $b_m = \alpha \quad F_g(p)$, $F_g(p)$, with $F_g(0) = 1$, representing the so-called measurement transfer function, and wherein the linear force f of the drive with armature set in linear movement, hereinafter designated as substitute acceleration signal $bE = f$, is also registered metrologically and accordingly is available as measured substitute acceleration signal bEm , it being assumed thereafter, as is customary in automatic control engineering, that on the one hand the measured acceleration signal b_m and on the other the measured substitute acceleration signal bEm , all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature set in linear movement engaged by the linear thrust to the position of the part of the linear acceleration meter in linear movement at which the effect used for registration of acceleration is generated being taken as a basis, is each scaled so that the relation $b_m = \alpha \quad F_g(p) = bEm \quad F_g(p)$ is satisfied, and wherein the measured acceleration signal b_m is delivered to the input of a low-pass filter with the low-pass transfer function $FT(p)$, $FT(0)$ preferably equalling 1, so that the signal $x = b_m \quad FT(p)$ can be received at the output of the low-pass filter, and wherein the

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disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque from the position of the rotated part of the rotary acceleration meter at which the rotary thrust of the drive is engaged to the position of the rotated part of the accelerometer at which the effect used for registration of acceleration is generated, basis, is each scaled so that the relation $b_m = \alpha \quad F_g(p) = b_{Em} \quad F_g(p)$ is satisfied, and wherein the measured acceleration signal b_m is delivered to the input of a low-pass filter with the low-pass transfer function $FT(p)$, $FT(0)$ preferably equalling 1, so that the signal $x = b_m \quad FT(p)$ can be received at the output of the low-pass filter, and wherein the measured substitute acceleration signal b_{Em} is delivered to the input of a high-pass filter with high-pass transfer function $FH(p) = FT(0) - FT(p)$ $F_g(p)$, so that the signal $y = b_{Em} \quad [FT(0) - FT(p) \quad F_g(p)]$ may be received at the output of this high-pass filter, and wherein a signal $z = b_m \quad FT(p) + b_{Em} \quad [FT(0) - FT(p) \quad F_g(p)]$ is formed in accordance with the relation $z = x + y$ and this synthesized signal z is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question.

7. A device and a process as described in Claim 6, wherein the armature current i_a of the direct-current fed winding of the drive is used as substitute acceleration signal $b_E = i_a$ in place of the torque m of the drive.

8. A device and a process as described in Claims 2 to 5, wherein the limit frequency value selected for the low-pass filter with low-pass transfer function $FT(p)$ is low enough so that, if the drive winding is energized by multiphase current by

way of a so-called pulse inverter and its output voltage space indicator on the output side operates on the principle of discrete-time change in switching condition control with a clock frequency in the 100-kHz range directly from a two-point control loop which adjusts the instantaneous value of the synthesized signal z to the set value of this signal, then no self-excited oscillations arise in this two-point control loop for the synthesized signal z .

9. A device and a process as described in one of Claims 6 or 7, wherein the limit frequency value selected for the low-pass filter with low-pass transfer function $FT(p)$ is low enough so that, if the drive winding is energized by direct current by way of a so-called pulse inverter and its output voltage is derived in accordance with the principle of discrete-time change in switching condition control with a clock frequency in the 100-kHz range directly from a two-point control loop which adjusts the instantaneous value of the synthesized signal z to the set value of this signal, then no self-excited oscillations arise in this two-point control loop for the synthesized signal z .

10. A device and a process as described in one of Claims 1 to 7, wherein the low-pass filter with low-pass transfer function $FT(p)$ is dimensioned so that its limit frequency is lower than 10 kHz.

11. A device and a process as described in one of Claims 1 to 10, wherein the circumstance constantly occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal αm is only incompletely described by the equation $\alpha m = Fg(p) \ bEm$ and accordingly, in order for the actual conditions to be taken

into account is to be replaced by the relation $\alpha_m = FM(p) Fg(p) bEm$, in which transfer function $FM(p)$ describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated is taken into account by replacing the high-pass filter in question with the high-pass transfer function $FH(p) = FT(0) - FT(p)$ $Fg(p)$ with a modified high-pass filter with modified high-pass transfer function $Fh(p) = FT(0) - FT(p)$ $Fg(p)$ $FM(p)$, it being advisable in this process not to determine the limit frequency of the low-pass filter with low-pass transfer function $FT(p)$ until the high-pass filter with high-pass transfer function $FH(p)$ has been replaced by a modified high-pass filter with modified high-pass transfer function $Fh(p)$.

12. A device and a process as described in one of Claims 1 to 10, wherein the circumstance constantly occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal α_m is only incompletely described by the equation $\alpha_m = Fg(p) bEm$ and accordingly, in order for the actual conditions to be taken into account, is to be replaced by the relation $\alpha_m = FM(p) Fg(p) bEm$, in which transfer function $FM(p)$ describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated is taken into account in approximation

by separating from the transfer function in question $FM(p)$ that part

$$F_0(p) = \frac{(1+p \cdot T_\mu) \cdot (1+2 \cdot D_v \cdot p \cdot T_v + p^2 \cdot T_v^2) \cdot \dots}{(1+p \cdot T_i) \cdot (1+2 \cdot D_j \cdot p \cdot T_j + p^2 \cdot T_j^2) \cdot \dots},$$

which allows for one or more poles and/or zero positions with particularly high values of T_μ , T_v , T_i , or T_j , and by replacing the high-pass filter in question with high-pass transfer function $FH(p) = FT(0) - FT(p)$ $Fg(p)$ with a modified high-pass filter with modified high-pass transfer function $Fh^*(p) \approx F\gamma(0) - FT(p)$

$F_8(p)$ $F_0(p)$, it being advisable not to determine the limit frequency of the low-pass filter with low-pass transfer function $FT(p)$ in this process until the high-pass filter with high-pass transfer function $FH(p)$ has been replaced by a modified high-pass filter with modified high-pass transfer function $Fh^*(p)$.

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